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Effect of selected Organic amendments on Germination and Yield of *Abelmoschus esculentus* (L.) moench grown under Chromium Stress

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ABSTRACT

Okra (*Abelmoschus esculentus* (L.) Moench) was used as test crop in a research trial to assess the impact of organic amendments (compost and farmyard manure) on germination and yield under application of chromium (Cr) stress. The no. of treatments applied was 10 while 3 replicates were used for each treatment. For inducing Cr stress, $K_2Cr_2O_7$ (potassium dichromate) solution of 50 mg/Kg concentration was applied to the soil. Cr treated and untreated soil samples were amended with compost and farmyard manure at 2.5 % and 5 %. It was demonstrated that in okra when compared with control, the sugar content and germination parameters were affected adversely by Cr application. The treatments of compost at 5 percent and farmyard manure at 2.5 percent positively affected the yield in both Cr treated and untreated plants. In comparative analysis compost appeared as more beneficial for okra than farmyard manure. Overall, the application of compost at 5 percent was found to be effective in improving yield characters, chlorophyll and sugar contents of Cr affected okra plants.

Keywords: Organic amendments, Chromium stress, Okra, Compost, Farmyard manure.

INTRODUCTION

Okra (*Abelmoschus esculentus* (L.) Moench), widely cultivated as a vegetable throughout the world is a member of Malvaceae (Ahmed *et al*., 2006). Poor disposal of tanning wastes (Shakir *et al*., 2012; Rafique *et al*., 2010), industrial waste water used for crop irrigation (Khan *et al*., 2013) and human activities like electroplating and mining (Oliveira, 2012; Singh *et al*., 2002) has significantly enhanced the chromium concentration in soil. For agronomic plants Cr is toxic at about 0.5 to 5.0 mg m L^{-1} in nutrient solution and 5 to 100 mg kg^{-1} of available Cr in soil (Hossner *et al*., 1998).

The organic amendments are defined as almost decomposed plant or animal materials which are capable of improving the physical, chemical and biological characteristics of soil after its addition (Bouajila and Sanaa, 2011; Naramabuye, 2004). Considered as a conventional approach, the composting procedure requires microbial action in aerobic environment for decaying and stabilizing the organic material originated from living sources (Smith & Collins, 2007). Farmyard manure is a decomposed combination of farm animal excreta with litter and straw (Sabir *et al*., 2015).

The present research was conducted to analyze and compare the impact of various organic amendments (farmyard manure & compost) on germination, yield and biochemical parameters of Cr stressed okra plants.

MATERIALS AND METHODS

Experimental site and test crop

The experiment was carried out in Botanical garden of Lahore College for Women University, Lahore in 2016 and okra (*Abelmoschus esculentus* (L.) Moench cv. Arka Anamika) seed was provided by Punjab Seed Corporation Lahore.

Soil survey and seeds sterilization

The soil samples were tested by measuring their pH and EC (electrical conductivity). The okra seeds were immersed in 2 percent $MgCl_2$ (Mercuric chloride) soln. for 10 minutes and washed 5 times thereafter.

Experimental set up

Using randomized complete block design (RCBD), the experimental set up was organized with thirty pots each containing seven kilograms soil and 10 okra seeds. Total no. of treatments applied was 10 while 3 replicates were used for each

Author Contribution: A.N., Planned the research, Performed the experimental work and manuscript writing; **S.I.,** Designed experiment, supervised the research and finalized the manuscript; **K.J.,** Assisted in Experimental procedures and analysis treatment. The soil was treated with $K_2Cr_2O_7$ solution of 50 mg/Kg concentration for inducing Cr stress. Cr treated and untreated soil samples were amended with compost and farmyard manure at 2.5 % and 5 %. In control (T1) samples, the stress and amendments were not applied.

For the measurement of germination percentage and seedling vigor index (SVI), analyses was carried out in line with the procedure of Close & Wilson, (2002) and Abdul Baki & Anderson, (1973), respectively. The samples of plants were selected at vegetative and reproductive phases and kept under the freezing conditions (at -35°C). For analyses of chlorophyll, proline and sugar content present in the leaf standard method according to Arnon, (1949), Dubois *et al*., (1956) and Bates *et al*., (1973) were used, respectively.

Estimation of yield

After harvest, the yield attributes of okra plants such as fresh weight of each fruit (g) and no. of fruits per plant were recorded for the yield estimation.

Statistical assessment

The experimental data was statistically analyzed by Analysis of Variance and Duncan's Multiple Range Test (Duncan, 1957) with COSTAT (Steel and Torrie, 1980) was used for comparing the values of group means.

RESULTS AND DISCUSSION

At first Cr affects the seed germination, so the tolerance level to this metal would be expressed by the seed germination potential under Cr application (Peralta *et al*., 2001). As indicated by Fig. 1 & 2, chromium significantly ($p < 0.05$) affected the germination percentage and SVI, compared to control. The results regarding Cr induced decreased germination % are in lines with those of (Samantary & Deo, 2004) and (Ganesh *et al*., 2006). The rise in protease functions (Zeid, 2001), restriction of amylase reactions and conduction of sugars to embryonic axis caused by Cr stress are considered as the probable reasons for decreased seed germination (Chidambaram *et al*., 2006; Zeid, 2001). According to results, in Cr treated plants, an insignificant effect of organic amendments on germination parameters was observed relative to unamended Cr affected plants.

The results depicted that in comparison to control, chlorophyll content was insignificantly affected in Cr stressed plants at the vegetative phase. According to Fig. 3, 4 & 5, compost applied at both levels and 2.5 % farmyard manure elevated the concentrations of Chl a, Chl b and total chlorophyll at vegetative phase of Cr treated plants.

In citrus (Wu & Xia, 2006), lettuce (Ali *et al*., 2007) and ginger (Ahmad *et al*., 2009), the addition of compost raised the levels of chlorophyll. According to (Anburani & Manivannan, 2002), the rise in chlorophyll content could be due to the nutrients supplied by farmyard manure. Similar results were observed by Nehra *et al*., (2001) and Sanwal *et al*., (2007). In wheat, the organic manure was involved in improving capability of plants to cope with stress and development of chlorophyll (Jan *et al*., 2014).

According to the results of present study, a pronounced rise in proline content of Cr affected plants was found at both vegetative and reproductive phases, when compared to control. Regarding proline content, similar results were observed by Yilmaz & Parlak, (2011), Nataraj *et al*., (2009) and Nataraj & Paramar, (2008). Zengin *et al*., (2005) reported a marked elevation in proline level of bean leaves when subjected to heavy metal (Mercury, cadmium, copper and lead) stress for a period of 10 days. The excess of proline is considered as an adaptive response of plants for the alleviation of adverse effects caused by Cr stress (Rai *et al*., 2004; Rout & Shaw, 1998). As shown in Fig. 6, at vegetative phase, Cr affected plants responded insignificantly to amendments with respect to proline content. However, reduction in proline content was registered in Cr affected plants at reproductive stage (Fig. 7) by compost application.

Considering sugar content, both the vegetative and reproductive phases of okra were adversely affected by Cr stress relative to control. Similar decrease in sugar content was observed in water lilies (Choo *et al*., 2006) and sugarcane (Jain *et al*., 2000). This stress induced decline in sugar could be due to the disturbances in photosynthetic reactions (Sundarmoorthy *et al*., 2015). Compost and farmyard manure effectively raised the sugar concentrations in Cr affected plants at the vegetative (Fig. 8) and reproductive phases (Fig. 9).

In comparison to control, the influence of Cr was insignificant on the yield attributes of okra. In Cr treated and untreated plants, the treatments with 5 % compost and 2.5 % farmyard manure have played a significant role in elevating yield (Fig. 10) and weight per fruit (g) relative to control (Fig. 11). In okra, the yield (Akanbi, 2002) and soil nutrient status (Haynes and Naidu, 1998; Garg and Bahla, 2008; El-Magd *et al*., 2006; Akanbi *et al*., 2000) could be improved by the addition of different rates of organic amendments. The enhanced phytoavailability of macronutrients as well as the enrichment of physical attributes of soil was observed after the incorporation of farmyard manure (Bhattacharyya *et al*., 2008).

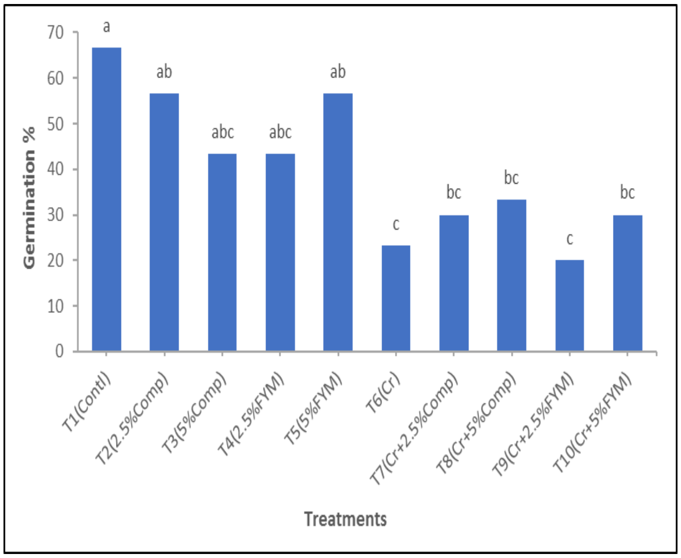

Fig. 1: Effect of chromium stress and application of organic amendments (compost and FYM) on germination percentage (%) of okra.

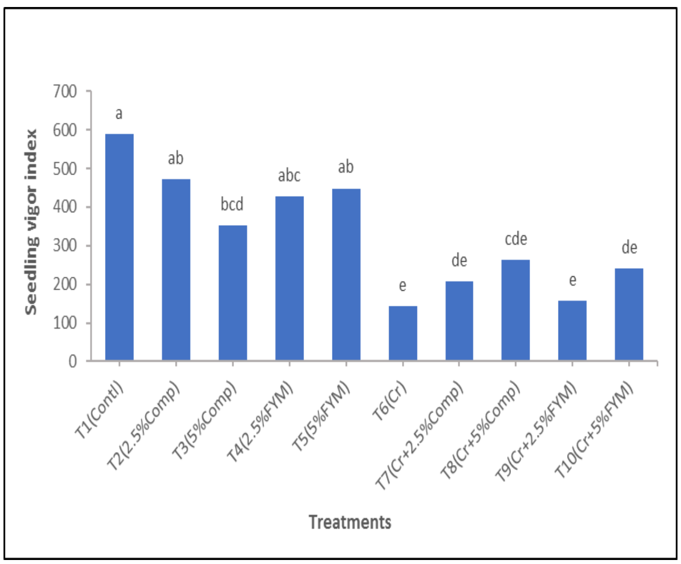

Fig. 2: Effect of chromium stress and application of organic amendments (compost and FYM) on seedling vigor index (SVI) of okra.

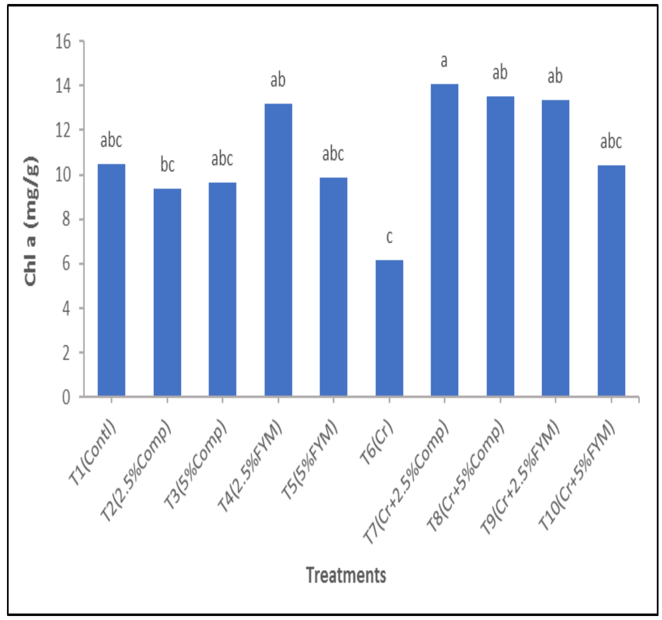

Fig. 3: Effect of chromium stress and application of organic amendments (compost and FYM) on chlorophyll a content (mg /g) of okra leaves at vegetative stage.

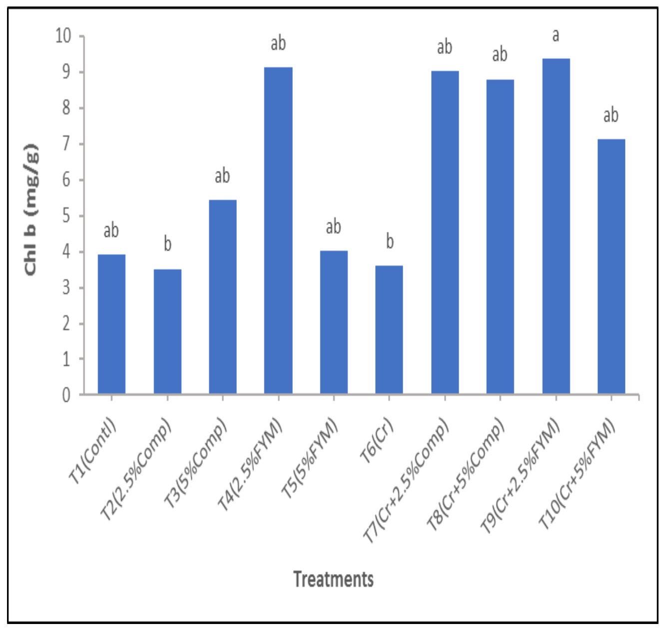

Fig. 4: Effect of chromium stress and application of organic amendments (compost and FYM) on chlorophyll b content (mg /g) of okra leaves at vegetative stage.

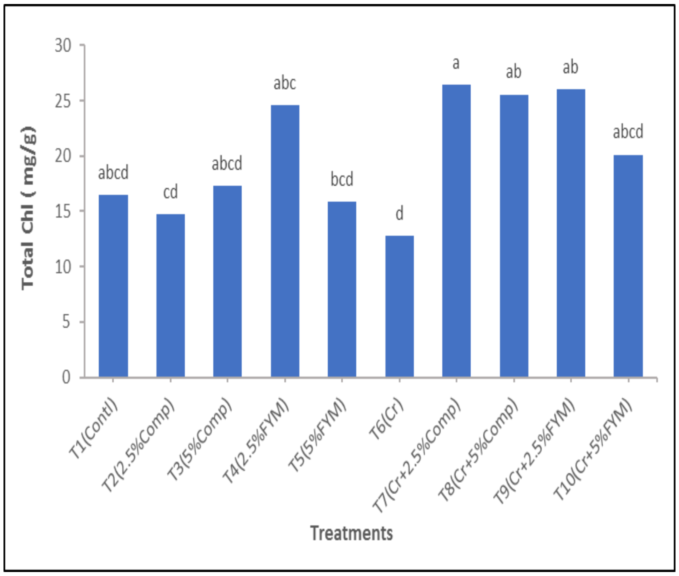

Fig. 5: Effect of chromium stress and application of organic amendments (compost and FYM) on total chlorophyll content (mg /g) of okra eaves at vegetative stage.

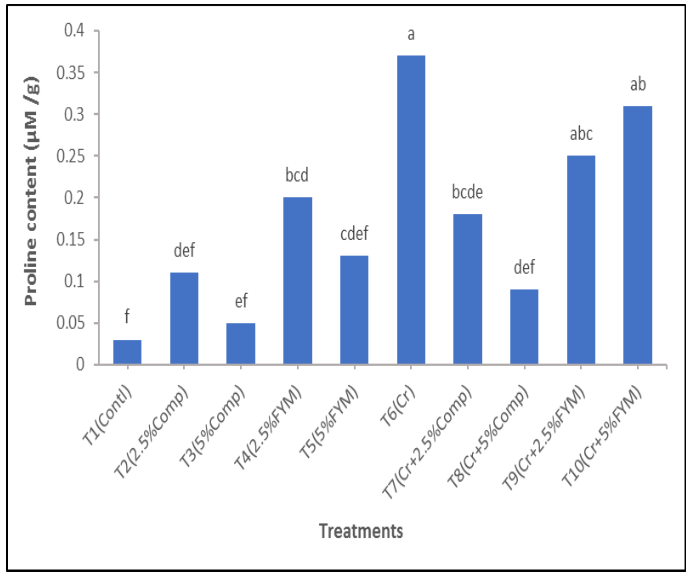

Fig. 7: Effect of chromium stress and application of organic amendments (compost and FYM) on proline content ((µM /g) of okra leaves at reproductive stage.

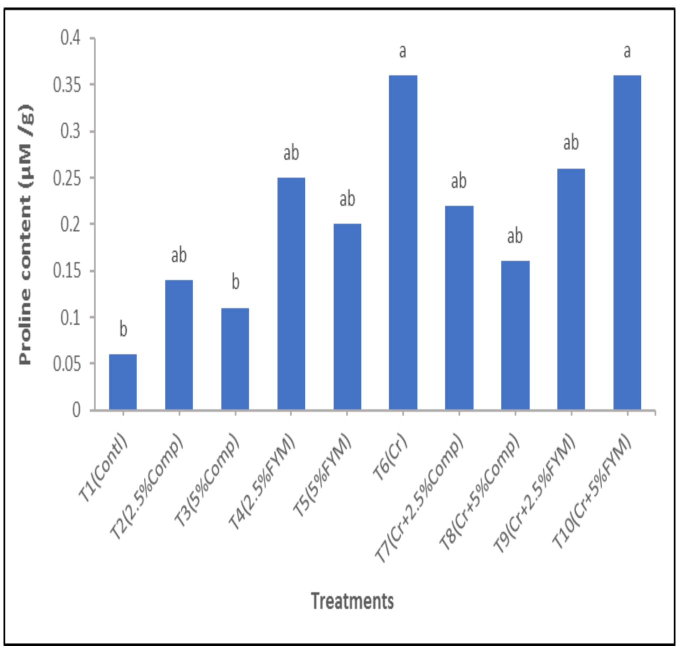

Fig. 6: Effect of chromium stress and application of organic amendments (compost and FYM) on proline content (µM /g) of okra leaves at vegetative stage.

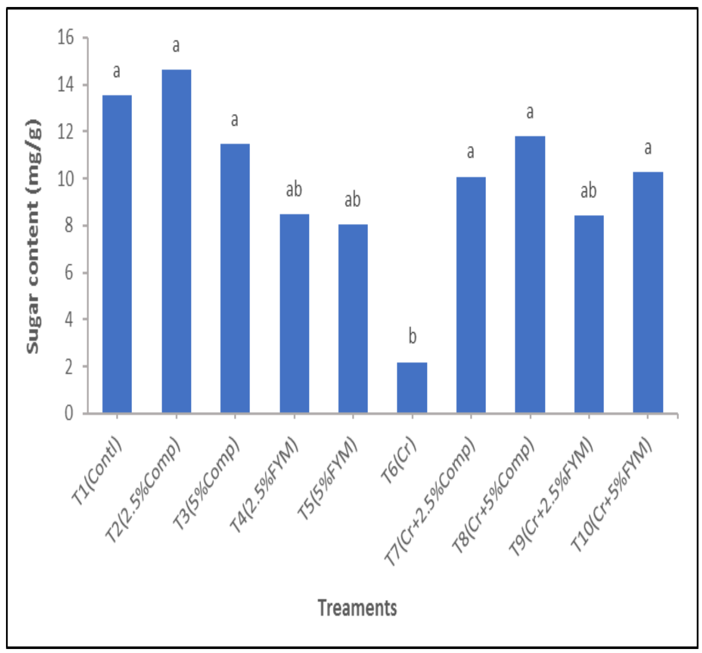

Fig. 8: Effect of chromium stress and application of organic amendments (compost and FYM) on sugar content (mg /g) of okra leaves at vegetative stage.

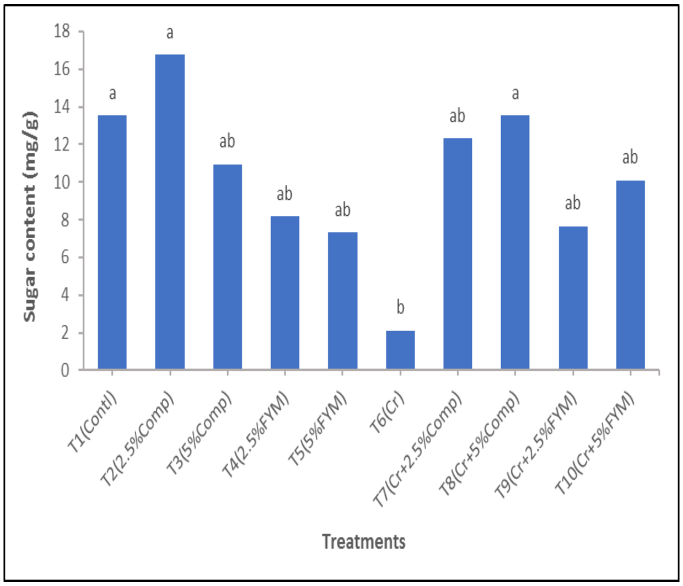

Fig. 9: Effect of chromium stress and application of organic amendments (compost and FYM) on sugar content (mg /g) of okra leaves at reproductive stage.

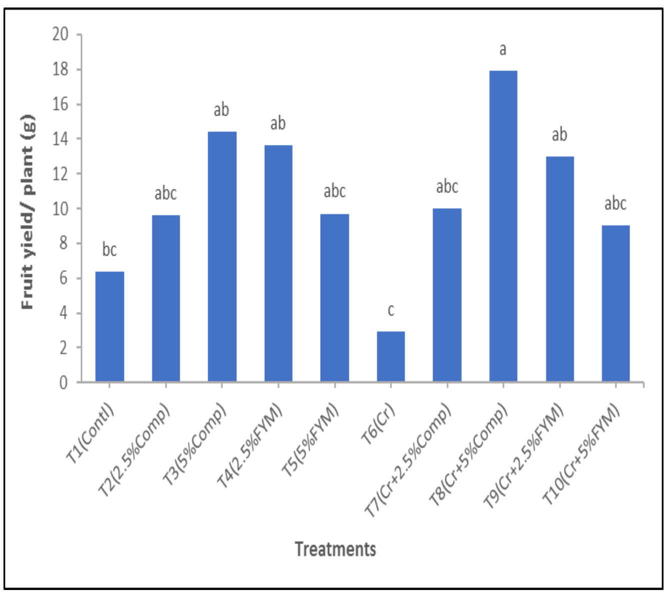

Fig. 10: Effect of chromium stress and application of organic amendments (compost and FYM) on yield / plant (g) of okra.

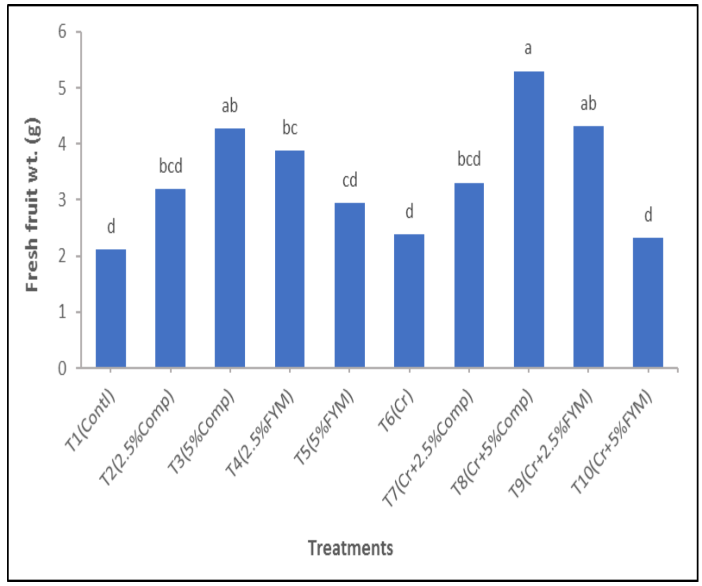

Fig. 11: Effect of chromium stress and application of organic amendments (compost and FYM) on fresh weight of fruit (g) of okra.

CONCLUSION

The results of study revealed a pronounced reduction in seed germination percentage, seedling vigor index and sugar content of okra plants after Cr application. The treatments of compost at 5 percent and farmyard manure at 2.5 percent positively affected the yield in both Cr treated and untreated plants. In comparative analysis compost appeared as more beneficial for okra than farmyard manure. Overall, the application of compost at 5 percent was found to be effective in improving yield characters, chlorophyll and sugar contents of Cr affected okra plants.

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